CLAIMS

What is claimed is:

1. A thermal transfer interface, comprising:

a thermal spreader forming a plurality of passageways and a mating lip within each of the passageways;

a spring element coupled with the spreader; and

a plurality of thermally conductive pins for the passageways, each of the pins having a head, shaft and barbed shaft end moving with the spring element, at least part of the shaft being internal to the passageway and forming a gap with an internal surface of the passageway, wherein the pin heads collectively and macroscopically conform to an object coupled thereto to transfer heat from the object to the spreader through the passageway gap formed between the spreader and each of the plurality of pins, the barbed shaft end of each of the pins engaging with the mating lip to retain the pins with the thermal spreader when the spring element is in an uncompressed state.

2. The thermal transfer interface of claim 1, the spring element forming a layer with a substantially planar face, each of the pin heads either (a) protruding from the face in a direction away from the spreader, (b) being substantially flush with the face or (c) being recessed within the spring element.

3. The thermal transfer interface of claim 1, each of the pin shafts being cylindrical, each of the passageways being substantially perpendicular to a planar surface of the spring element and being cylindrical to accommodate motion of the shafts therethrough.

4. The thermal interface of claim 1, each of the pin shafts being rectangular, each of the passageways being substantially perpendicular to a planar surface of the spring element and being rectangular to accommodate motion of the shafts therethrough.

5. The thermal transfer interface of claim 1, the object comprising one or more semiconductor packages and dies.

6. The thermal transfer interface of claim 1, the spring element comprising a thermally conductive sponge-like material.

7. The thermal transfer interface of claim 6, the sponge-like material being positioned between the thermal spreader and the object.

8. The thermal transfer interface of claim 7, the sponge-like material positioned between the thermal spreader and the pin head.

9. The thermal transfer interface of claim 6, the sponge-like material being positioned within each of the passageways to bias the pins towards the object.

10. The thermal transfer interface of claim 1, the thermal spreader forming a vent opening to one or more of the passageways.

11. The thermal transfer interface of claim 1, the spring element comprising a plurality of helical springs disposed within the passageways, each of the helical springs disposed within a separate one of the passageways between the mating lip and shaft, for biasing the pins outwardly from the spreader towards the object.

12. The thermal transfer interface of claim 1, the spring element comprising a plurality of helical springs coaligned with the passageways, each of the helical springs arranged to bias a separate one of the pins outwardly from the spreader towards the object.

13. A thermal transfer interface, comprising:

a thermal spreader forming a plurality of passageways and a retaining tab at the end of each of the passageways;

a spring element coupled with the spreader; and

a plurality of thermally conductive pins for the passageways, each of the pins having a head and shaft moving with the spring element, at least part of the shaft being internal to the passageway and forming a gap with an internal surface of the passageway, wherein the pin heads collectively and macroscopically conform to an object coupled thereto to transfer heat from the object to the spreader through the passageway gap formed between the spreader and each of the plurality of pins, each

shaft forming a shoulder that engages with the retaining tab to retain the pins with the thermal spreader when the spring element is in an uncompressed state.

14. The thermal transfer interface of claim 13, each of the pin shafts being cylindrical, each of the passageways being substantially perpendicular to a planar surface of the spring element and being cylindrical to accommodate motion of the shafts therethrough.

15. The thermal interface of claim 14, each of the pin shafts being rectangular, each of the passageways being substantially perpendicular to a planar surface of the spring element and being rectangular to accommodate motion of the shafts therethrough.

16. The thermal transfer interface of claim 14, the object comprising one or more semiconductor packages and dies.

17. The thermal transfer interface of claim 14, the thermal spreader forming a vent opening to one or more of the passageways.

18. The thermal transfer interface of claim 14, the spring element comprising a plurality of helical springs, each of the helical springs disposed within a separate one of the passageways between the shaft and thermal spreader, for biasing the pins outwardly from the spreader toward the object.

19. The thermal transfer interface of claim 14, the spring element comprising a sponge-like material disposed within each of the passageways, to bias the pins outwardly from the spreader toward the object.

20. A thermal transfer interface, comprising:

a thermal spreader forming a plurality of passageways;

a retaining plate coupled to the thermal spreader and having one or more retaining tabs forming one or more apertures;

a spring element coupled with the spreader; and

a plurality of thermally conductive pins for the passageways, each of the pins having a head and shaft moving with the spring element, at least part of

the shaft being internal to the passageway and forming a gap with an internal surface of the passageway, wherein the pin heads collectively and macroscopically conform to an object coupled thereto to transfer heat from the object to the spreader through the passageway gap formed between the spreader and each of the plurality of pins, each shaft forming a shoulder that engages with one of the retaining tabs to retain the pins with the thermal spreader when the spring element is in an uncompressed state.

21. The thermal transfer interface of claim 20, each of the pin shafts being cylindrical, each of the passageways being substantially perpendicular to a planar surface of the spring element and being cylindrical to accommodate motion of the shafts therethrough.

22. The thermal interface of claim 20, each of the pin shafts being rectangular, each of the passageways being substantially perpendicular to a planar surface of the spring element and being rectangular to accommodate motion of the shafts therethrough.

23. The thermal transfer interface of claim 20, the object comprising one or more semiconductor packages and dies.

24. The thermal transfer interface of claim 20, the thermal spreader forming a vent opening to one or more of the passageways.

25. The thermal transfer interface of claim 20, the spring element comprising a plurality of springs, each of the springs disposed within a separate one of the passageways to bias the pin head outwardly from the spreader towards the object.

26. The thermal transfer interface of claim 20, the spring element comprising a sponge-like material disposed within each of the passageways to bias the pins outwardly from the spreader towards the object.

27. The thermal transfer interface of claim 20, each of the apertures corresponding to one of the passageways, wherein one of the retaining tabs retains a corresponding one of the pins within the one passageway.

28. The thermal transfer interface of claim 20, each of the apertures corresponding to two or more passageways, wherein one of the retaining tabs retains two or more pins within the two or more passageways.

29. A method for transferring thermal energy from an object to a thermal spreader, comprising the steps of:

biasing a plurality of pins against the object so that the plurality of pins contact with, and substantially conform to, a macroscopic surface of the object;

communicating thermal energy from the object through the pins and through a plurality of air gaps between the pins and the thermal spreader; and

retaining the pins to passageways of the thermal spreader so that the pins are retained with the thermal spreader when unbiased against the object.

30. The method of claim 29, the step of biasing comprising biasing a plurality of pin heads against the object utilizing a plurality of helical springs coaligned with the passageways.

31. The method of claim 29, the step of biasing comprising utilizing thermally-conductive sponge-like material disposed between the object and at least part of the pins.

32. The method of claim 29, the step of biasing comprising utilizing thermally-conductive sponge-like material disposed within the passageways.